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HISTORICAL PERSPECTIVE

OF THE

DEPARTMENT OF ADMINISTRATION

DATA PROCESSING DIVISION

1965 - 1976

Established by Executive Order in January, 1965, the Data Processing Division was created to provide centralized data processing services to all state agencies. Subsequently, there has been a tremendous change in the operation of the Division and it is thought appropriate to develop a historical perspective for those who are interested in the development and present status of this Division.

In this perspective only those developments which are believed to be of special significance are discussed both to stress certain developments and keep the document brief. It is expected that this document will be updated periodically to provide a current record.

HISTORY OF DATA PROCESSING DIVISION

DEPARTMENT OF ADMINISTRATION

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INTRODUCTION

The first commercial computers, which utilized the internally stored program concept, became available in 1955. In 1958, an IBM 650 computer was installed at Montana State University for use in research and as an instruction aid. In 1959, an IBM 650 computer was also installed at the Department of Highways. At this time the only business related computing, of any magnitude, being done in state government was at the Department of Highways. For some time the Department of Highways had been using two IBM 602A's for accounting and statistical purposes. These were electromechanical computers with very limited capabilities.

The Department of Highways developed the first major governmental applications which required the capabilities of a computer. These were the earthwork calculations and payroll applications. Others followed rapidly.

Additional computers were not installed in state government until 1961, when Montana State University installed an IBM 1620-1 computer to replace the IBM 650 which was becoming obsolete. In 1962 the Department of Highways installed an IBM 1620-1 and an IBM 1401 computer to replace the IBM 650 which could no longer handle the workload.

In 1963, the Liquor Control Board installed an IBM 650 computer to automate the inventory control function, but the capacity of the system was found to be inadequate and an IBM 1440 computer was installed in 1964 to replace the IBM 650.

Also in 1964, Montana State University upgraded its IBM 1620-1 to an IBM 1620-2 in order to meet its increased computation demands. The IBM 1620-1 was transferred to the University of Montana. This provided the University of Montana with its first computer processing capability.

During this same period, the Workmen's Compensation Division ordered an IBM 1440 computer. At this time, concern developed regarding the proliferation of computers in state government. From the experiences of other states it was obvious that computing needs in state government would continue to expand and that many agencies would request computer systems at considerable cost to the state.

In response to this need, the Governor issued Executive Order 5-76. The Executive Order established a data processing committee and directed the Department of Administration, with cooperation of other departments, to prepare a five-year plan for the development of data processing.

As outlined in the Executive Order, the basic functions of the Data Processing Policy Committee shall be to:

"1. coordinate, assist, and set general policy direction in the development of a long-range data processing plan as provided in hereinafter;

2. review alternatives and make recommendations for adoption of data processing policies and, when necessary, administrative or legislative action;

3. serve in an advisory capacity for new concepts in information systems; and

4. make recommendations to resolve problems which may arise in consolidation of data processing services."

In addition, the Department of Administration was directed....

"...in accordance with general policy direction established by the Data Processing Policy Committee, and in cooperation with other departments of the executive branch, to develop and annually update a long-range data processing plan for the fiscal years of 1977 through 1981.

The plan shall provide for the most effective and efficient utilization and coordination of data processing personnel and facilities, with proper consideration being given to the developing technology, the need for collecting, storing, transferring, retrieving, and safeguarding data files and data processing equipment, and the State's future needs for data processing facilities and applications. The Department shall submit the plan to the Office of the Governor by December 31, 1976."

With the aid of a consulting firm and a project team, the plan was developed and submitted to the Governor.

GROWTH OF THE DATA PROCESSING DIVISION

EQUIPMENT

In January 1965 the equipment and personnel from the Department of Revenue, Fish and Game, Administration along with the Workmen's Compensation Division was physically consolidated in the basement of the Mitchell Building. The Workmen's Compensation Division's IBM 1440 Computer was to supply the computing needs for the center. As applications were converted to the computer, extra equipment was returned to the vendor.

In the consolidation planning it was recognized that the capacity of the IBM 1440 Computer would soon be exceeded. Therefore, an IBM 360/30 Computer had been ordered and was installed in October 1966. This computer, initially, had considerable unused capacity which, by the central services concept, was made available to all state agencies which were interested. Many new applications were developed and the utilization of the computer increased substantially. It was soon recognized that additional computing capacity would again be needed.

An IBM 360/40 Computer was installed in September of 1970 to replace the IBM 360/30. This nearly doubled the computing potential and projections at the time indicated this capacity would be sufficient for three to five years. This was the first computer system which really had the capacity for an on-line bill drafting system (ALTER) which was installed in time for the 1972 Legislative Session.

During the 1972 Legislative Session it became obvious that the capacity of the IBM 360/40 would not be adequate for the next Legislative Session and additional computing capability would be needed. Because of the short time frame it was decided that an IBM 370/135 would be installed in December 1972 on a temporary basis to replace the IBM 360/40. At the same time, a formal request for bids on a much larger computer was developed for installation in 1973.

During 1972, the Employment Security Division was offered an IBM Model 360 Computer, at no cost, from the U. S. Department of Labor. An IBM 360/30 was accepted from the U. S. Department of Labor in 1973, and installed in the Department of Administration's data processing center for administration and operational management.

The addition of the IBM 360/30 allowed the Data Processing Bureau to operate in a duplex mode. There are many benefits when operating in a duplex mode but the greatest saving to both Employment Security Division and the Data Processing Bureau was attained by the pooling of peripherals. This being that all peripherals on an individual basis can be switched from one computer mainframe to another as the need arises.

In January 1973, the mainstay of the unit-record equipment was released. The IBM 408 accounting machine was capable of limited processing and with the other unit record equipment processed data for eighteen years. The processing speed was slow and usually involved many manhours to process data. All processing performed by the 408 was transferred to the computer.

In September 1973 an IBM 370/145 Computer was installed which was projected to meet the expanding computation needs for a minimum period of $2\frac{1}{2}$ years. During the next year it was determined that the IBM 370/145 would have to be replaced at the mimimum time projected. Also, technological changes appeared to be stabilizing and while the technological obsolescence of the next computer may be three to five years, the useful life would probably be five to eight years. In addition, a requirement of the next computer would be the capability of large expansion and, because of the long-term useful life, should be purchased.

In February of 1975, the Legislature authorized the purchase of an IBM 370/158 on a time pay basis not to exceed eight years. The Legislature granted this request with the understanding that the purchase would be made from the

Data Processing Revolving Fund and that the present computer rates would not be increased. The purchase was consummated as soon as practical to save rental payments which were being made on the IBM 370/145. The IBM 370/158 was then installed in October 1975 and replaced the IBM 370/145.

The 370/158 allows large numbers of teleprocessing (TP), remote job entry (RJE) and/or conversational remote job entry (CRJE) to function simultaneously. By 1977, a large network of terminals was operational. The new computer configuration produced processing capabilities many times that possessed in 1966 (Figure 1).

FIGURE 1

DATA PROCESSING BUREAU

10 YEAR COMPUTER CONFIGURATION COMPARISON

1966 System Configuration	1977 System Configuration	Increase Capability
IBM 360 Mod 30-32K	IBM 370 MOD 158 - 1,500 K	Increased main memory by a factor of 46.9. Increased internal speed by a factor of 20.
1 Selector Channel	3 Selector Channels Internal Timer Storage Protection	Allows multi-programming in sixteen partitions with teleprocessing.
1100 LPM Printer	1100 LPM Printer 2000 LPM Printer	Increase lines/minute by a factor of 2.8.
1000 CPU Card Read	1000 CPM Reader 600 CPM Reader	Increased card reading capability by 60%.
300 CPM Punch	300 CPM Punch	Same capacity.
3 Disk Drives 21,750 K Bytes	12 Disk Drives 2,400,000 K Bytes	Increased on-line storage by a factor of 110.
4 Tape Drives 30KB	7 Tape Drives 320KB	Increased speed of tape drives by a factor of 10.6. Increased number of drives by a factor of 1.75.
2 Computer Operators	8 Computer Operators	Increased number of computer operators by a factor of 4.
System Value* $367,325	System Value* $2,739,580	Increased equipment value by a factor of 7.5

* Purchase Price

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SOFTWARE

Software assists the central processing unit in processing data. These computer programs are usually acquired from outside sources and serve a particular function. Table 1 itemizes the most significant software packages.

TABLE 1

SYSTEM SOFTWARE ACQUISITIONS

Fiscal Year	Vendor	Name	Function
1966	IBM	DOS	Computer Operating System Resident on Disk Space
1970	Informatics, Inc.	MARK IV	File Management System
1972	DYLAKOR Computer Systems	DYL-250	Utility Report Generator
1972	Software Design, Inc.	GRASP	Spooler for Printing
1973	Panasophic Systems, Inc.	PANVALET	Random Storage Direct Access Library System
1973	IBM	OS/MFT	Major Computer Operating System Utilizing Fixed
1974	IBM	OS/VS1	Partition Sizes
1974	IBM	CRJE	Conversational Remote Job Entry
1974	IBM	RJE	Remote Job Entry
1975	Whitlow Computer Systems, Inc.	SYNCSORT II	Utility Sort
1975	IBM	CICS	Customer Information Control System
1975	University of California	BMD	Statistical Analysis
1976	University Computing Co.	UCC-1	Tape Management System Real-Time

The Data Processing Division installed the IBM Disk Operating System (DOS) on the IBM 360/30 in 1966. Version 4 was installed which was very basic. During the ensuing years IBM enhanced the DOS operating system until three jobs could be processed concurrently and contained some teleprocessing capability.

In August, 1970, the Highway Department and the Department of Planning and Economic Development, currently known as Department of Community Affairs, agreed to jointly purchase the MARK IV file management system. Two installations were made, one being the Department of Administration's Data Processing Center, and the other in the Department of Highways Data Processing Center.

The primary concept of MARK IV is the ability to manipulate files of data. MARK IV processes files that already exist and it can be also used as a tool for creating new files. Its greatest asset is the ability to produce "quicky" reports with a minimum of programming time.

DYL-250 was originally leased in 1972. This general purpose system has the ability to create files, generate test data, print sample reports, compress and restore records, and update existing files. This software package is of great assistance to programmers and systems analysts in the process of development and evaluation of new computer systems. DYL-250 was used extensively and was purchased in January, 1974.

With the IBM 360/40 under DOS, each of the three simultaneously executed jobs was required to output directly. Therefore, if all three jobs required the printer, two jobs were required to wait until the other had completed printing. This created a printing "bottleneck". To alleviate this problem, a software package called GRASP, was leased in March 1972. GRASP is an automatic spooling system for the IBM 360 which operates asynchronously with the other programs.

Upon completion, the printer output is "spooled" (saved) if the printer is being utilized by another job. This allows the partition to begin execution of another program. When the printer becomes available, the information on the "spooler" is printed. With the conversion of the systems to Operating System (OS), the GRASP lease was cancelled in February of 1975.

The security of the computer programs is of much concern to a data processing installation. Early in 1973, it was decided to order PANVALET, a software package that is a random storage direct access library system designed for the storage, protection, retrieval, maintenance, and control of all programs, Job Control Language (JCL), and card image files. This allows all computer programs to be stored on a disk file instead of a card deck in a file cabinet.

In 1972, it was determined that to meet the users needs it was necessary to convert to the IBM Operating System (OS) which had many additional capabilities. This was a major undertaking and required approximately one third of the programming staff for a period of one year to convert the nearly 3,000 programs to the new operating system. OS conversion began in mid-1973 and was completed early in 1975.

OS can allocate main storage to jobs; control the sharing of common areas of main storage; load object programs; control the concurrent execution of programs and routines; support remote job entry; etc. OS supports the same languages as DOS, which include:

- ASSEMBLER
- COBOL
- FORTRAN Level G
- PL1 Level F
- RPG

With the conversion to OS, the next logical step was to install Conversational Remote Job Entry (CRJE) and Remote Job Entry (RJE). This expanded the capability of State Government to utilize teleprocessing. CRJE was installed in April of 1974 and RJE in November 1974. Both were additional features to the OS system with no additional cost.

The CRJE provides remote access to the operating system from printer-keyboard terminals. Authorized terminal users can conversationally prepare and update programs and data, submit them for processing and receive the output either at the central installation or the remote terminal.

RJE has greater capabilities than CRJE. It provides the remote terminal users with the same batch processing facilities that are available at the central installation. It allows jobs to be submitted from a terminal and output to be routed back to the same terminal and/or to other terminals. Besides accepting job input and routing output, RJE provides for sending messages between users and showing job or terminal status.

In May 1975, SYNCSORT II was leased. SYNCSORT II is a disk sorting package, which uses its own timing and resource usage optimizing features to perform highly efficient sorts. Benchmark tests showed this package to be very efficient.

In June 1975, Customer Information Control System (CICS) was ordered for the 370/158 computer. CICS is a data communications controller with limited data base capabilities. CICS simplifies the on-line communications interface by isolating user applications from the communications and operating environments. Consequently, on-line applications can be developed as easily as similar batch programs. By 1977, over 50 terminals were on-line using CICS.

Many problems in research require extensive analyses of large amounts of data. As far as possible, the data handling process should be automatic and rapid. The research worker should have the appropriate data processing capability for the type of analysis required. To accomplish this purpose, the BMD Biomedical Computer Program was purchased in December 1975. This package consists of a variety of computer programs of which one can be selected to produce a particular type of statistical analysis.

As the Data Processing Center has grown, management of the tape library has become difficult. The tape library had grown to over 6,000 reels of tape by 1976 with a projected growth of 2,000 additional reels per year. To assist in the management of the tape library, a software package called UCC-ONE was purchased in March 1976. This tape library management system eliminates operator and librarian "accidents" by providing tight security control. It features a tape aging procedure, and produces accounting and reporting information.

PERSONNEL

The transfer of personnel from the agencies being consolidated was effective
July 1, 1965. With the addition of several new positions, the staff of the Data
Processing Division consisted of approximately 32 full time equivelants (FTE)
during fiscal 1966 (Table 2).

TABLE 2

Number	Classification
1	Director of Data Processing
1	Clerk Typist
1	Systems Analyst
2	Computer Programmers
1	Supervisor of Data Processing
2	Data Processing Supervisors
4	Computer Operators
1	Machine Operator
1	Supervisor of Data Acquisition
18	Keypunch Operators
32	

During the ensuing years the staff of the Division has been expanded and
now the budget for fiscal 1977 anticipates approximately 117 FTE's. This increase
in personnel has shown not only the growth of data processing in Montana but is
parallel to the growth of data processing as an industry. The Data Processing
Division equipment has expanded from the original unit record equipment to the
present computer processor. Likewise, the duties and responsibilities of the
employees have also expanded. Considerable staff is required to fully utilize the
capabilities of a large computer processor. This staff is organized as shown in
Figure 2. The increase in personnel has occurred over a period of time and is

illustrated graphically in Figure 3. The average annual cost per employee has
increased at approximately 9% per year (Table 3). This cost includes all employee
benefits and overtime.

TABLE 3

Fiscal Year	Full Time Employees	Percent Increase	Personnel Expenditures	Percent Increase	Average Cost Per Employee	Percent Increase
1966	32	-	$ 164,888	-	$ 5,153	-
1967	39	22%	209,806	27%	5,380	4%
1968	42	8%	245,230	17%	5,839	9%
1969	53	26%	303,182	24%	5,720	-2%
1970	57	8%	354,877	17%	6,226	9%
1971	59	4%	426,942	20%	7,236	16%
1972	63	7%	478,511	12%	7,595	5%
1973	76	21%	638,237	33%	8,398	11%
1974	94	24%	821,889	29%	8,744	4%
1975	104	11%	1,049,551	28%	10,092	15%
1976	112	8%	1,208,241	15%	10,788	7%
1977*	117	4%	1,475,439	22%	12,611	18%
Average Annual Increase		13%		22%		9%

*Budget

Figure 2

Data
Processing
Division

Division
Administration

Statewide
Planning And
Coordinating

Systems
Development
Bureau

Computer
Services
Bureau

Technical
Services
Bureau

Single Agency
Systems
Section

Multi-Agency
Systems
Section

Data
Entry
Section

Digitizing
And Plotting
Section

Production
Control
Section

Computer
Operations
Section

Computer
Software
Support
Section

Research And
Development
Section

Systems
Design And
Development

Systems
Design And
Development

Key
Entry
Of Data

Tape And Disc
Library
Control

Computer
Supplies
Management

Computer
Center
Operations

Computer
Operating
Systems

Equipment
And Software
Evaluation

Systems
Enhancement
And
Maintenance

Systems
Enhancement
And
Maintenance

Key
Verification
Of Data

Job
Scheduling

Computer
Scheduling

Computer
Teleprocessing
Systems

Equipment
And Software
Installation
Planning

In-House
Training

User
Liaison

Job
Set-Up And
Report
Control

Equipment
Utilization
And
Reporting

Bursting
And Deleaving

Teleprocessing
Network Control

FUNCTIONAL CHART

DEPARTMENT
OF ADMINISTRATION

June, 1976

Figure 3

Data Processing Division
Personnel Growth

Number of FTE's

Fiscal Year
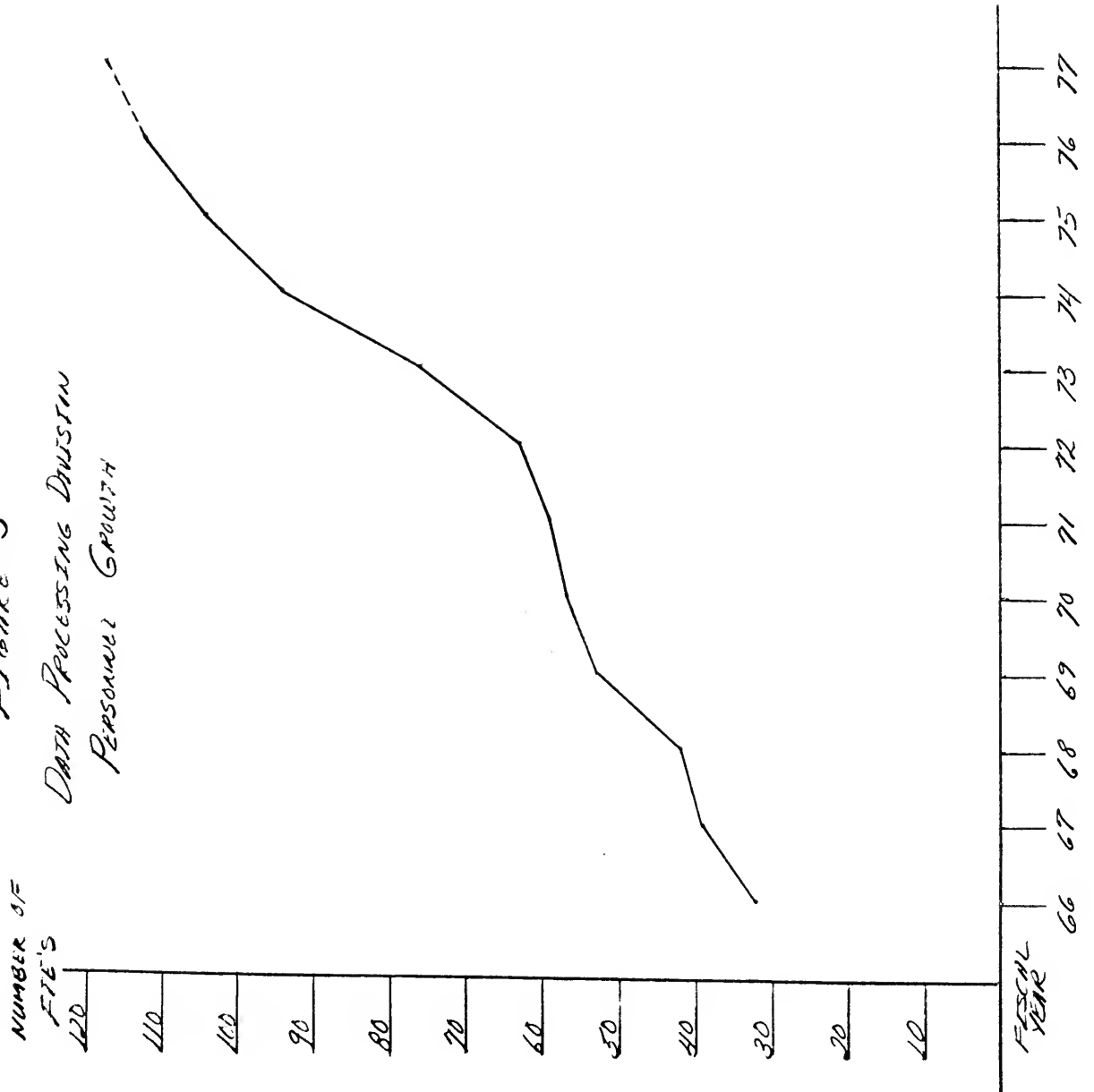
FISCAL

As noted previously, the Data Processing Division is operated on a cost recovery basis. All services performed are billed to the user agency at established rates. Funds are not appropriated to the Data Processing Revolving Account. The appropriation made from the Data Processing Revolving Account is authority to spend the funds collected for data processing services performed.

In order to operate, it has been necessary to establish and maintain an operating cash balance in the Data Processing Revolving Account. This was accomplished gradually over a period of several years by billing for data processing services at a rate slightly higher than necessary for actual cost recovery. The establishment of an operational cash balance was necessary in order to meet the monthly cash flow requirements. The equipment and personnel expenditures are made approximately 30-45 days in advance of actually billing for services performed.

Then, in fiscal 1971 the Department of Administration established a policy concerning this operating cash balance. The policy was to maintain an average monthly cash balance equivalent to 25% of the anticipated expenditures for the fiscal year. The 25% rule was established so the Data Processing Revolving Account would not likely be placed in a financial crisis caused by unavoidable contingencies, e.g., the termination of a major data processing program, or unanticipated increases in costs for equipment and personnel.

Figure 4 shows the total accumulated income and expenditures for the Data Processing Revolving Account since the account was established. The accumulated totals as of June 30, 1976, are:

Income $11,793,419

Expenditures $11,020,562

Fund Balance $ 772,857

Figure 5 shows the monthly cash balance of the Data Processing Revolving Account for the current and three prior fiscal years. The average monthly cash balance has increased slightly each fiscal year. It should be noted that the 25% rule is being maintained based upon actual expenditures. In fact, the last fiscal year's average cash balance was 20% of actual expenditures, which is well within the established rule. Figure 6 shows graphically the distribution of expenditures during the entire period.

The following Table 4 shows the cost distribution as compared with national averages obtained from the 1975-76 NASIS report. It should be noted that the percentages have remained relatively constant during the entire period.

TABLE 4

	Personnel	Equipment	Supplies, Etc.
Data Processing Division 1965-1976 Average	55%	35%	10%
Data Processing Division Projected 1977	55%	35%	10%
National Average Fiscal 1976	50%	41%	9%

This comparison indicates that the Data Processing Division is expending more for personnel and less for computer equipment than the national average. The difference is partially explained by the fact that terminals, lines and modems in the teleprocessing network are not included in the Data Processing Division Budget.

MILLIONS
OF DOLLARS

FIGURE 4

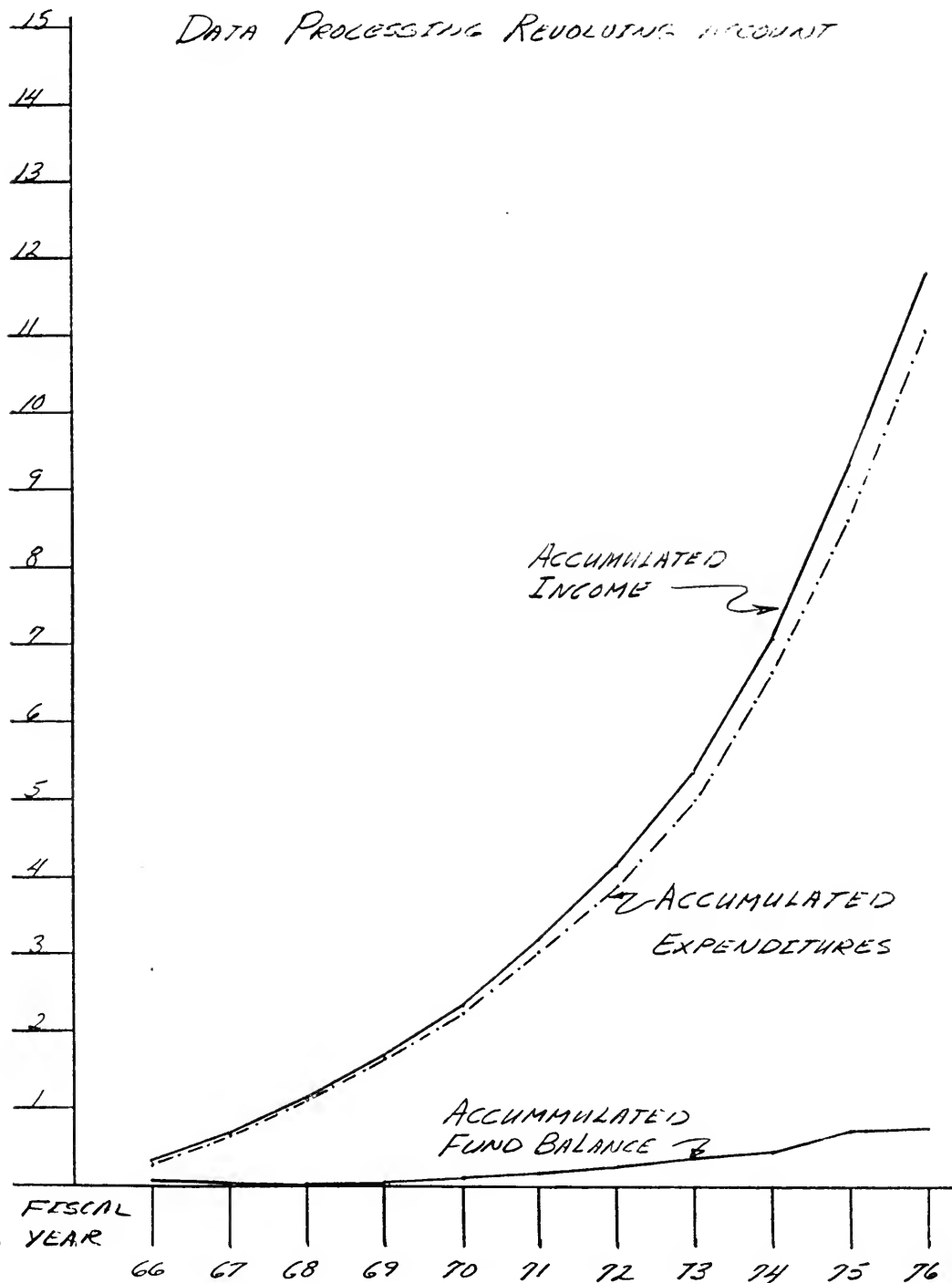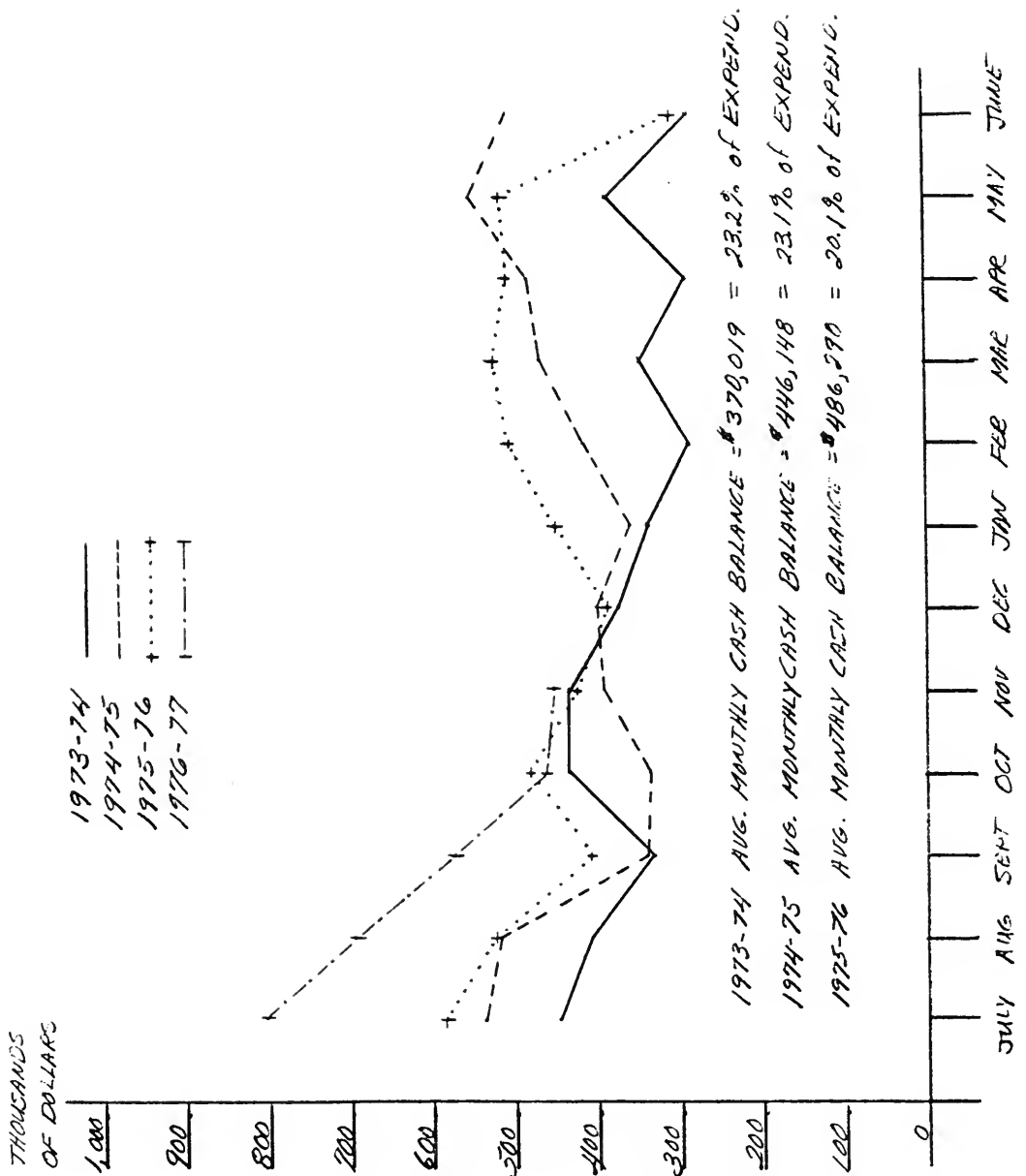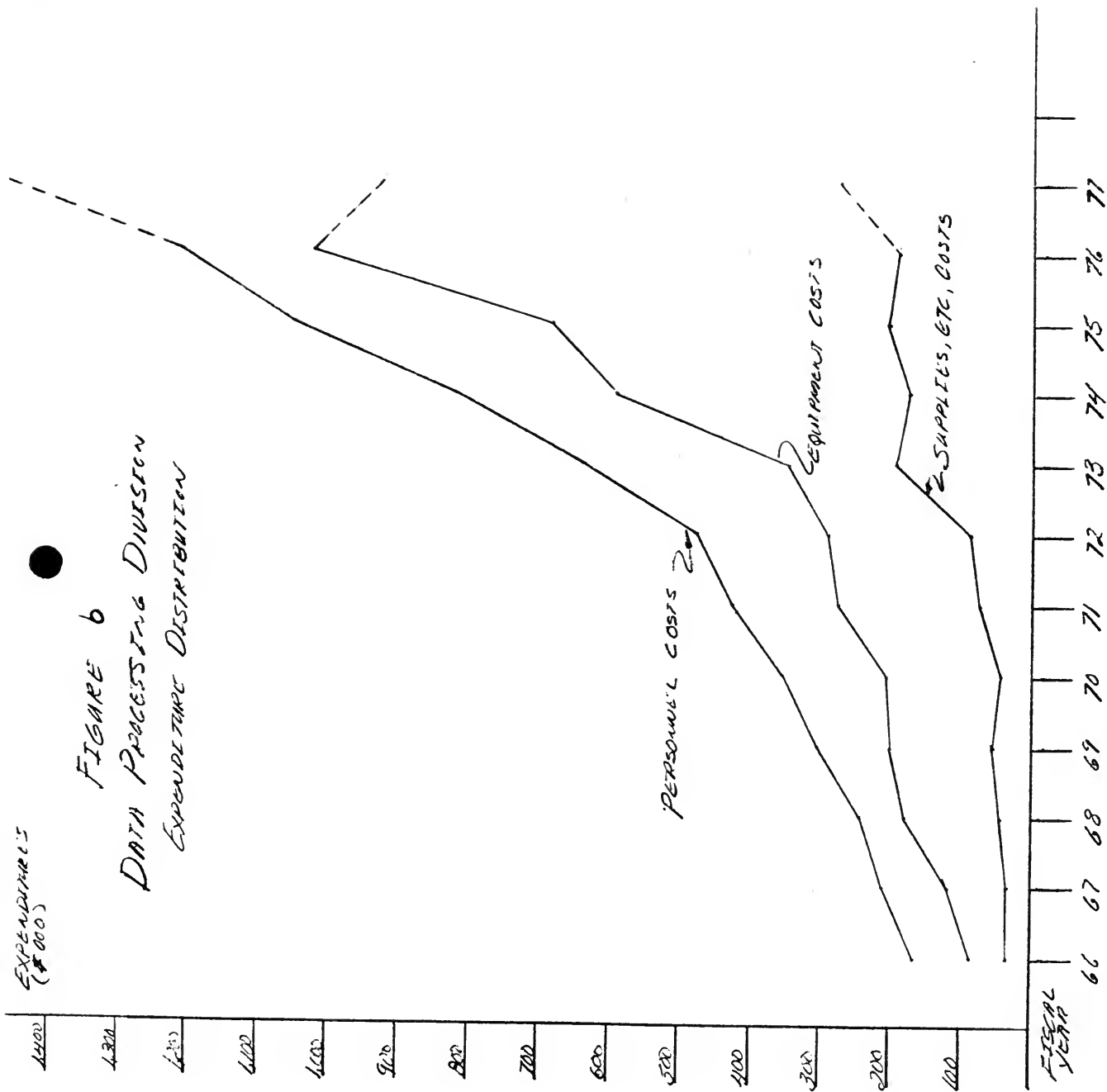DATA PROCESSING REVOLVING ACCOUNT

ACCUMULATED INCOME

ACCUMULATED EXPENDITURES

ACCUMMULATED FUND BALANCE

FISCAL YEAR

66 67 68 69 70 71 72 73 74 75 76

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FIGURE 5

DATA PROCESSING REVOLVING ACCOUNT
CASH BALANCE

THOUSANDS
OF DOLLARS

1,000
900
800
700
600
500
400
300
200
100
0

JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE

1973-74 ————
1974-75 — — —
1975-76 ·······+
1976-77 —·—·—

1973-74 AVG. MONTHLY CASH BALANCE = $370,019 = 23.2% of EXPEND.

1974-75 AVG. MONTHLY CASH BALANCE = $446,148 = 23.1% of EXPEND.

1975-76 AVG. MONTHLY CASH BALANCE = $486,270 = 20.1% of EXPEND.

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FIGURE 6
DATA PROCESSING DIVISION
Expenditure Distribution

EXPENDITURES ($000)

PERSONNEL COSTS

EQUIPMENT COSTS

SUPPLIES, ETC. COSTS

FISCAL YEAR

66 67 68 69 70 71 72 73 74 75 76 77

100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400

Since 1966, the computer rate has been considerably reduced. The rate is computed based upon the time required by the computer to execute instructions in central processing unit seconds. The rate is then computed based on a machine unit hours (MUH). In 1966, the computer rate was $120.00 per MUH. The 1977 rate has been reduced by 68% and is at $38.00 for each MUH. Included in this rate is the overhead which has increased several times during this period of time.

The effect of the rate reduction has been documented over a period of time and is recognizable, e.g., the Statewide Budgeting and Accounting System (SBAS) was developed, and implemented beginning in fiscal year 1973. The following Table 5 shows the reduction in cost of each accounting transaction by fiscal year.

TABLE 5

Fiscal Year	Total Number of Transactions	Total Cost	Cost Per Transaction
1973	1,454,579	$242,000	.1664
1974	2,013,273	302,961	.1505
1975	2,346,810	313,460	.1336
1976	2,932,041	226,321	.0772

PRODUCTION

The processing power of a computer system is difficult to measure as there are many factors which influence the amount of processing which can be done. The potential of a computer system to process work is greatly dependent upon the type, speed and number of peripheral devices on the system, such as printers, disk drives, tape drives, etc.

The quantity of main memory has been used as a standard by industry to gauge the processing power of a computer system. Using this criteria, Figure 7 demonstrates that the processing power provided by the Division has increased by a factor of 46.9 over the past ten years.

The amount of computer processing performed during this period is also shown in Figure 7. Until fiscal year 1972, the processing and computer capacity remained relatively parallel but then diverge, with the processing growing at a faster rate than the computer capacity. This is due to the fact that the capacity of the computer system is utilized more efficiently in a multiprogramming environment.

The computer production is believed to reflect total output of the Data Processing Division. That is; for computer processing to take place systems must be designed and programmed, and information must be transcribed by data entry for computer processing.

The measurement of computer productivity is the machine unit hour (MUH), which is developed by a formula which attempts to measure the amount of resources used. Table 6 shows the number of MUH's produced annually, which is also shown graphically in Figure 7. The total machine unit hours (MUH's) shown are not all billable because administrative processing, reruns and system software support are included. (Approximately 25% is not billable.) But, the total represents the work performed on the computer system.

TABLE 6

Fiscal Year	Machine Unit Hours	MUH Rate
1966	1,943	$120.00
1967	2,202	120.00
1968	2,294	120.00
1969	3,300	120.00
1970	3,264	115.00
1971	3,397	115.00
1972	4,348	115.00
1973	7,987	90.00
1974	17,096	70.00
1975	24,115	54.00
1976	32,290	54.00
1977	37,584 (projected)	38.00